

CLAIMS

What is claimed:

5 1. A method for treating the exterior of a contaminated, unfertilized shell egg, comprising the steps of:

 (a) placing said shell egg in a sealed vessel, wherein the internal pressure of said sealed vessel is equal to atmospheric pressure;

 (b) increasing the pressure inside said vessel to greater than atmospheric pressure

10 10 by introducing gaseous ozone into said sealed vessel; and

 (c) maintaining said shell egg in said sealed vessel following said increase in pressure for a period of at least one minute.

20 2. The method of claim 1, wherein said shell egg is at or below room or ambient temperature prior to treatment.

25 3. The method of claim 1, wherein said contamination further comprises contamination by bacteria or other microorganisms.

30 4. The method of claim 3, wherein said contamination is reduced by at least $5 \log_{10}$ cfu/g.

 5. The method of claim 1, wherein, following said introduction of gaseous ozone, the internal temperature of said sealed vessel is maintained at a temperature of about 1 to 50°C.

35 6. The method of claim 1, wherein said introduction of gaseous ozone increases the internal pressure of said sealed vessel to about 1 to 40 psi above atmospheric pressure.

 7. The method of claim 1, wherein the total concentration of said gaseous ozone in said sealed vessel is about 20 to 40% V/V.

 8. The method of claim 1, wherein said shell egg remains in said sealed vessel for a period of about 2 to 90 minutes following the introduction of said gaseous ozone into said sealed vessel.

9. The method of claim 1, wherein said gaseous ozone is generated by electrochemical means external to said sealed vessel, and is applied at a concentration greater than the concentration of ozone present in ambient air.

5 10. A method for reducing bacterial contamination on the exterior of an unfertilized shell egg by at least $5 \log_{10}$ cfu/g, comprising the steps of:

(a) placing said contaminated shell egg in a sealed vessel, wherein said sealed vessel has an internal pressure equal to atmospheric pressure and an internal temperature of about 4 to 25^0C ;

10 (b) increasing the pressure inside said vessel to about 15 psi above atmospheric pressure by introducing gaseous ozone into said sealed vessel, wherein the final concentration of said gaseous ozone is about 20 to 40% V/V; and

(c) maintaining said shell egg in said sealed vessel following said increase in pressure for a period of at least ten minutes.

15 11. A method for treating the exterior of a contaminated, unfertilized shell egg, comprising the steps of:

(a) exposing said shell egg to ultraviolet light;

20 (b) placing said contaminated shell egg in a sealed vessel, wherein the internal pressure of said sealed vessel is equal to atmospheric pressure;

(c) increasing the pressure inside said vessel to greater than atmospheric pressure by introducing gaseous ozone into said sealed vessel; and

(d) maintaining said shell egg in said sealed vessel following said increase in pressure for a period of at least one minute.

25 12. The method of claim 11, wherein the wavelength of said ultraviolet light is 254 nm.

13. The method of claim 11, wherein the intensity of said ultraviolet light is about 1500 to $2500 \mu\text{W}/\text{cm}^2$.

30 14. The method of claim 11, wherein, following said introduction of gaseous ozone, the internal temperature of said sealed vessel is maintained at a temperature of about 1 to 50^0C .

15. The method of claim 11, wherein said introduction of gaseous ozone raises the internal pressure of said sealed vessel to about 5 to 15 psi above atmospheric pressure.

16. The method of claim 11, wherein the concentration of said gaseous ozone in said 5 sealed vessel is about 20 to 40% V/V.

17. The method of claim 11, wherein said contaminated, unfertilized shell egg remains in said sealed vessel for a period of about 2 to 3 minutes following the introduction of said gaseous ozone into said sealed vessel.

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18. The method of claim 11, wherein said gaseous ozone is generated by electrochemical means external to said sealed vessel, and is applied at a concentration greater than the concentration of ozone present in ambient air.

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19. A method for treating the interior of a contaminated, unfertilized shell egg, comprising the steps of:

- (a) placing said shell egg in a sealed vessel, wherein the internal pressure of said sealed vessel is equal to atmospheric pressure;
- (b) decreasing the pressure inside said vessel to less than atmospheric pressure;
- (c) introducing gaseous carbon dioxide into said sealed vessel;
- (d) introducing gaseous ozone into said sealed vessel; and
- (e) maintaining said shell egg in said sealed vessel following said introduction of gaseous ozone for a period of at least one minute.

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20. The method of claim 19, wherein said the internal pressure of said sealed vessel is decreased to about 5 to 15 psi below atmospheric pressure.

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21. The method of claim 19, wherein said gaseous carbon dioxide is first introduced into said sealed vessel until a pressure of about 5 psi above atmospheric pressure is achieved, and wherein said gaseous ozone is subsequently injected into said sealed vessel until a 30 pressure of about 15 psi above atmospheric pressure is achieved.

22. The method of claim 19, wherein the concentration of said gaseous ozone in said sealed vessel is about 20 to 40% V/V.

23. The method of claim 19, wherein said gaseous ozone is generated by electrochemical means external to said sealed vessel, and is applied at a concentration greater than the concentration of ozone present in ambient air.

5 24. The method of claim 19, wherein said shell egg remains in said sealed vessel for a period of about 2 to 10 minutes following the introduction of said gaseous ozone into said sealed vessel.

25. A method for treating the interior of a contaminated, unfertilized shell egg,

10 comprising the steps of:

- (a) heating said shell egg;
- (b) transferring said heated shell egg to a sealed vessel, wherein the internal pressure of said sealed vessel is equal to atmospheric pressure;
- (c) decreasing the internal pressure of said sealed vessel to below atmospheric pressure;
- (d) introducing gaseous ozone into said sealed vessel; and
- (e) maintaining said shell egg in said sealed vessel following said introduction of gaseous ozone for a period of at least one minute.

15 20 26. The method of claim 25, wherein said gaseous ozone is introduced in an amount sufficient to increase the internal pressure of said sealed vessel to a pressure which is at or above atmospheric pressure.

25 27. The method of claim 25, wherein said egg is heated to a temperature of about 57 to

60°C.

28. The method of claim 25, wherein said egg is heated for a period of about 15 to 30 minutes.

30 29. The method of claim 25, wherein, prior to the introduction of said gaseous ozone, the internal pressure of said sealed container is decreased to about 5 to 15 psi.

30. The method of claim 25, wherein said gaseous ozone is introduced into said sealed container until an internal pressure of 15 psi above atmospheric pressure is obtained.

31. The method of claim 25, wherein said shell egg is treated with gaseous ozone for a period of about 10 to 30 minutes.

32. A method for treating the interior of a contaminated, unfertilized shell egg, 5 comprising the steps of:

- (a) heating said shell egg;
- (b) transferring said heated shell egg to a sealed container, wherein the internal pressure of said sealed container is equal to atmospheric pressure;
- (c) decreasing the internal pressure of said sealed vessel to below atmospheric 10 pressure;
- (d) introducing gaseous carbon dioxide into said sealed vessel;
- (e) introducing gaseous ozone into said sealed vessel; and
- (f) maintaining said shell egg in said sealed vessel following said introduction of gaseous ozone for a period of at least one minute.

15 33. The method of claim 32, wherein said gaseous carbon dioxide and said gaseous ozone are introduced in an amount sufficient to increase the internal pressure of said sealed vessel to a pressure which is at or above atmospheric pressure.

20 34. The method of claim 32, wherein said shell egg is heated to a temperature of about 58°C.

25 35. The method of claim 32, wherein said shell egg is heated is for a period of about 10 to 30 minutes.

36. The method of claim 32, wherein, prior to the introduction of said gaseous carbon dioxide and said gaseous ozone, the internal pressure of said sealed container is decreased to about 5 to 15 psi below atmospheric pressure.

30 37. The method of claim 32, wherein said gaseous carbon dioxide is first introduced into said sealed vessel until a pressure of about 5 psi above atmospheric pressure is achieved, and wherein said gaseous ozone is subsequently injected into said sealed vessel until a pressure of about 15 psi above atmospheric pressure is achieved.

38. The method of claim 32, wherein said shell egg is treated with said gaseous carbon dioxide and said gaseous ozone for a period of about 10 to 30 minutes.